"HANDS ON" SCIENCE

TITLE: Pendulums

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Cuba City Elementary

GRADE LEVEL: Sixth

PENDULUMS

Background Information.

If you take a small weight and suspend it from a string, then pull the weight to one side and let it go, it will swing back and forth. You will have made a pendulum.

The Italian physicist Galileo discovered the laws of the pendulum while watching a hanging church lamp swinging.

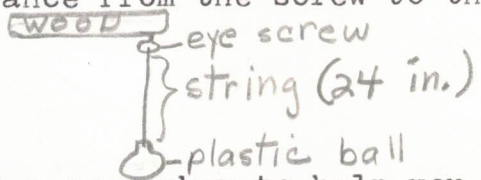
Let's see if we can "discover" some of the laws about pendulums!

Materials.

1. 1 plastic ball with hooks 
2. 2 weights (1 small, 1 large) 
3. 1 piece of wood with an eye screw 
4. ruler
5. colored pencils
6. about 26 inches of string
7. graph paper
8. scissors

Procedure.

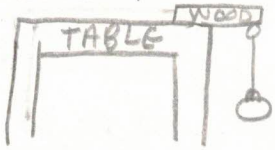
Step 1. Cut a piece of string about 26 inches long. Tie one end of it through the eye screw. Make a knot. Push the blue top down on the plastic ball; put the long end of the string under the hook. Measure the distance from the screw to the hook and set the string at 24 inches.



Step 2. You will need a co-worker to help you continue with the experiment.

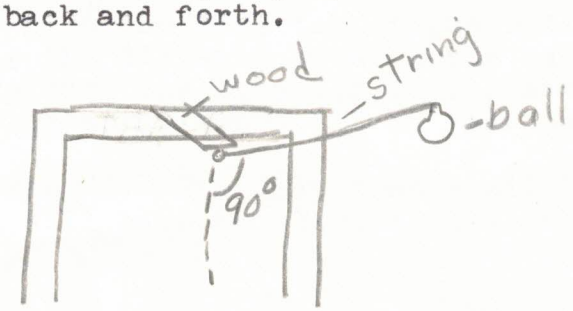
Put the wood stick over the edge of the table so the ball hangs down toward the floor. Have your co-worker hold the wood firmly so the eye screw is about 7 inches from the table edge.

(side view)



Face the table, and with your right hand raise the ball to table height keeping the string tight, so that when you release the ball, it will swing back and forth.

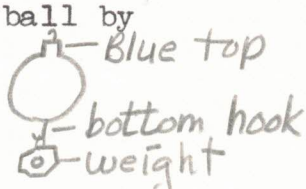
(front view)



You are now ready to experiment and collect data. Have your co-worker time the experiment in seconds while you count the number of swings. The special name for each complete swing (from the time it leaves your hand until it returns) is called the period of vibration and the path the ball travels is called the arc.

When you release the ball, your co-worker should start timing. When you release the ball, count 15 complete swings (over and back makes one swing). At the end of the 15th swing, say stop immediately so your co-worker can stop timing. Do a practice run first. When you finish timing this part of the experiment, make a graph like Graph 1, page 4 and record your results in red as directed on the graph.

Step 3. Let's see what happens if we attach a weight to the ball. Push down on the blue top of the ball until a hook shows at the bottom of the ball. Attach the small weight to the ball by putting the string attached to the weight over the hook.



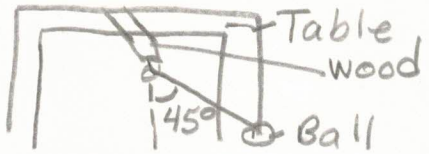
Now repeat step 2 with the small weight attached. Record results again, in red, on Graph 1.

Were you surprised at the results?

Step 4. Remove the small weight from the ball by pressing down on the blue top and unhooking the string. Take the larger weight from the box and attach in in the same manner as the small weight. Repeat step 2 using the larger weight. Record results on Graph 1, again using red pencil.

Step 5. The next step is to shorten the arc (or swing). Do you predict it will take more or less time for the ball to make 15 swings? Try it! This time, when you get ready to release the ball, only go half as high. Look closely at the diagram.

(front view)



Have your co-worker time while you count 15 swings. Record your results on Graph 2 in red.

Step 6. Repeat step 3, but use the 45^0 (shorter) arc. Record results on Graph 2 in red.

Step 7. Repeat step 4, using the 45^0 (shorter) arc. Record results on Graph 2 in red.

Were you surprised at the results when you changed the distance the ball traveled? Do you think the same thing will happen if you change the length of the string (pendulum)? Let's try it!

Step 8. Push down on the blue top of the ball. Pull the string through the hook until the distance between the ball and the eye screw is 8 inches. Release the blue top so the string will be held. Cut off the extra string so it won't get in your way.

Step 9. Repeat step 2. The only change will be instead of 24 inches of string, you will have 8. Record results on Graph 1 in blue.

Steps 10-11. Repeat steps 3 and 4, using 8 inches of string for the pendulum. Record results on Graph 1 in blue.

Steps 12, 12, 14. Repeat steps 5,6, and 7 (using the 8 inch pendulum). Record results on Graph 2 in blue.

Comparing and contrasting data.

Place the two graphs you have made on the table so you can see both of them. Refer to them to help you answer the following questions Answer the questions on another sheet of paper. Use complete sentences.

1. What effect, if any, did decreasing the arc have on the time it took the bob (ball) to make 15 swings?

2. What effect, if any, did adding weight have?

3. Did changing the length of the pendulum change the time it took the ball to make 15 swings?

4. If the time did change on any of the experiments, did the change follow a pattern?

5. Write several sentences (or a brief papagraph) summarizing and generalizing your findings.

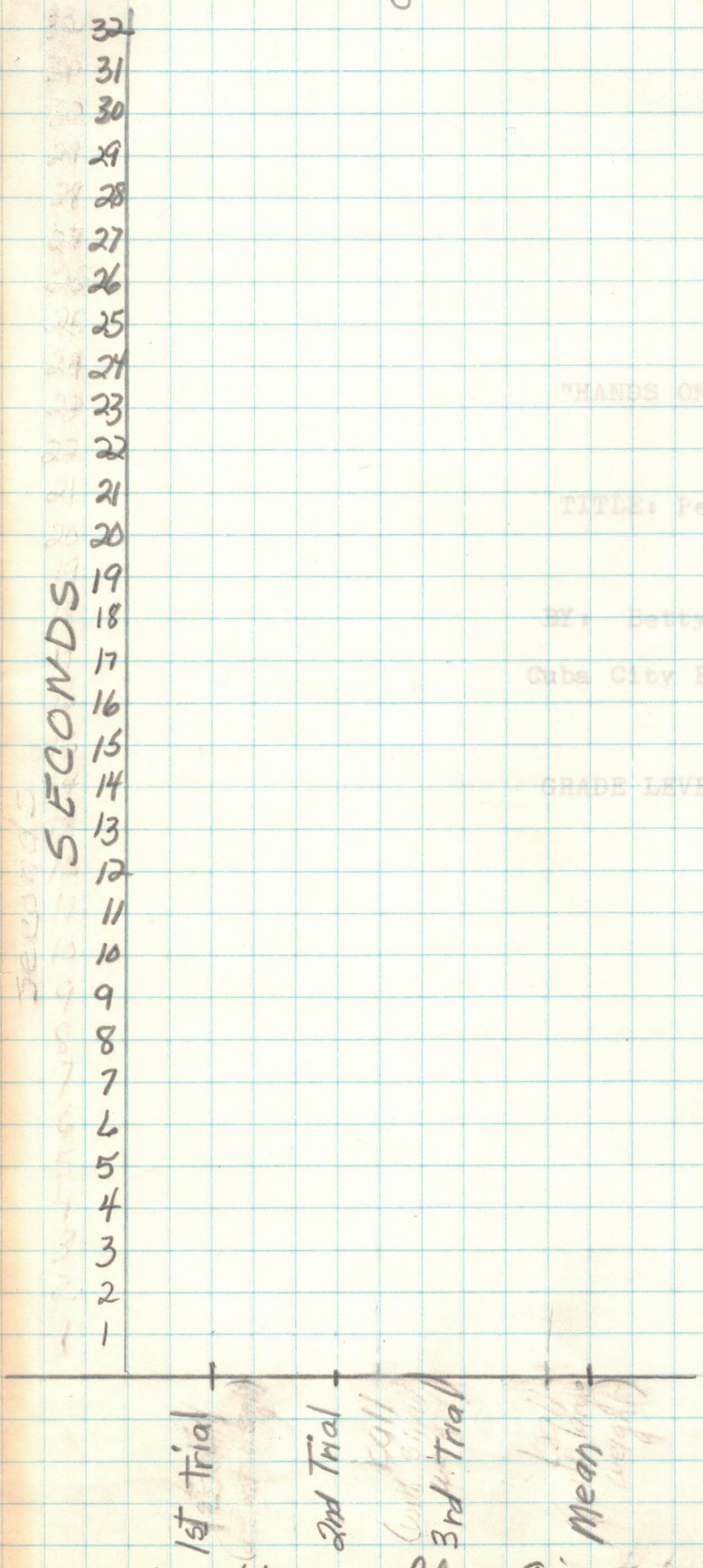
Further reasoning.

From what you have learned, can you deduct why clock pendulums have a device which can be used to raise or lower the bob (weight) on the pendulum?

PENDULUM EXPERIMENT

GRAPH 1 - (lighter bob)

TIME FOR FIFTEEN SWINGS
(90° release - straight out from stick)



GRAPH 2 - (heavier bob)

TIME FOR FIFTEEN SWINGS
(45° release - half way between straight out and straight down)